Probing critical behavior of Ising ferromagnet with diluted bonds using Wang-Landau algorithm

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Abstract

Randomness is an important subject in the study of phase transition as defect and impurity may present in any real material. The critical behavior of a pure system can be affected or even ruined by the presence of randomness. Here we study ferromagnetic Ising model on a square lattice with a presence of randomness in the form of bond dilution. The pure system of this model is known to experience second order phase transition, separating the high temperature paramagnetic phase and low-temperature ferromagnetic phase. A slightly different type of randomness, in the form of rewired lattices have been studied in the context of spin glass studies(1; 2; 3) We presently probe how the concentration of bond dilution in affecting the critical behavior of the system. We used Wang-Landau(4) algorithm of Monte Carlo simulation and calculated the correlation ratio in probing the existing critical phenomena. The correlation ratio is a compelling physical quantity to examine critical properties and had been applied in several previous studies(5; 6). We observed the existing lower temperature ordered phase preserved upto certain concentration of dilution and totally ruined when the bonds no longer percolated.

Keywords: Ising model, bond dilution, critical phenomena, Wang-Landau algorithm, Monte Carlo simulation.

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